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## *Microtus chrotorrhinus.* By Gordon L. Kirkland, Jr. and Frederick J. Jannett, Jr.

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### *Microtus chrotorrhinus* (Miller, 1894)

#### Rock Vole

*Arvicola chrotorrhinus* Miller, 1894:190. Type locality head of Tuckerman's Ravine, 3,500 ft., Mount Washington, Coos Co., New Hampshire.

*Microtus chrotorrhinus* Bangs, 1896:49, first use of name combination.

**CONTEXT AND CONTENT.** Order Rodentia, Suborder Myomorpha, Family Muridae, Subfamily Microtinae, Tribe Microtini. The genus *Microtus* has approximately 44 species distributed in North America and northern Eurasia (Corbet and Hill, 1980). Three subspecies of *Microtus chrotorrhinus* are recognized (Hall, 1981), as follows:

*M. c. chrotorrhinus* (Miller), 1894:190, see above.  
*M. c. rarus* Bangs, 1898:188. Type locality Black Bay, Strait of Belle Isle, Labrador.  
*M. c. carolinensis* Komarek, 1932:158. Type from Great Smoky Mountains of North Carolina, about 5 mi (airline distance) N of Smokemont, Swain Co., on a tributary of Bradley Fork, a small branch of the Oconalufy River, 3,200 ft.

**DIAGNOSIS.** The rock vole (Fig. 1) resembles the meadow vole (*Microtus pennsylvanicus*) in size and proportions but is distinguished by its yellowish-orange snout and yellow-brown dorsal pelage. *M. pennsylvanicus* lacks this ochraceous facial wash and generally has a dark chestnut brown dorsum. The skulls of the two voles can be differentiated on the basis of the size and shape of the incisive foramina and the morphology of the second upper molar. The incisive foramina of adult rock voles are shorter (generally <4.74 mm) and are not markedly tapered posteriorly. In *M. pennsylvanicus*, the incisive foramina are longer (generally >5.00 mm) and are constricted posteriorly. In samples of 17 *M. chrotorrhinus* and 18 *M. pennsylvanicus* from Essex County, New York (unpubl. data from adults in the Vertebrate Museum mammal collection), the respective means, standard deviations, and ranges for palatal slit length (in mm) were  $4.28 \pm 0.29$  (3.80 to 4.85) and  $5.22 \pm 0.21$  (4.95 to 5.55). The M2 of *M. chrotorrhinus* has three closed dentine triangles (in addition to an anterior loop) and no posterior loop. The M2 of *M. pennsylvanicus* has three closed triangles of dentine followed by a posterior loop of variable size and shape. The rock and meadow voles are usually ecologically segregated with the former being a forest-dweller and the latter a resident of meadows and other herbaceous communities. On occasion, meadow voles (presumably dispersing individuals) are taken in forests. The two species may occur together on the summits of mountains (J. N. Layne, in litt.) and in forest clearcuts (Kirkland, 1977).

The yellow-cheeked vole (*Microtus xanthognathus*) is the only other North American *Microtus* possessing a yellowish-orange snout and yellowish-brown dorsal pelage. Beyond this superficial resemblance, these two voles are easily distinguishable. *M. xanthognathus* is considerably larger, having total, tail and hindfoot lengths of 186 to 226 mm, 45 to 53 mm, and 24 to 27 mm, respectively (Banfield, 1974). The flank glands are conspicuous in *M. xanthognathus* but are lacking in *M. chrotorrhinus*, which possesses hip glands instead (Jannett, unpubl.). The incisive foramina of *M. xanthognathus* are long and taper posteriorly.

In the field, *M. chrotorrhinus* might be confused with the heather vole (*Phenacomys intermedius*), which is sympatric with the rock vole over part of its range (Peterson, 1966). Some populations of *Phenacomys* have yellow faces, but their tails are shorter (24 to 41 mm) than those of rock voles (Whitaker, 1980). The molars of *Phenacomys* are rooted in adults; they are rootless and evergrowing in *M. chrotorrhinus*. In *Phenacomys*, the inner reentrant angles of the lower molars are deeper than the outer. The reentrant angles of the inner and outer sides of the lower molars are approximately equal in *M. chrotorrhinus*.

**GENERAL CHARACTERS.** *Microtus chrotorrhinus* is a medium-sized vole. Standard external measurements (in mm) are: total length, 140 to 185; length of tail, 42 to 64; length of hindfoot, 18 to 24; and length of ear, 12 to 18. Weight is 30 to 48 g. Selected cranial measurements of 20 adults (in mm) from West Virginia are: condylobasal length, 25.0 to 27.7; least interorbital breadth, 3.7 to 4.1; zygomatic breadth, 14.2 to 16.0; and length of maxillary toothrow, 6.05 to 6.9 (Kirkland, 1977). The skull of *M. chrotorrhinus* is shown in Fig. 2. Sexual dimorphism is slight; males average larger in most series. *M. c. carolinensis* is characterized by having a larger skull, longer upper toothrow and heavier zygoma than other subspecies (Komarek, 1932).

Upper parts are grayish bister to bright glossy bister with black-tipped hairs. The face has a yellowish to dull orange-rufous wash. This is most prominent on the snout and decreases in intensity towards the ears. The extent and intensity of the ochraceous pigmentation varies with age and geographic locality. Some individuals have a dull yellowish wash on the rump. Specimens in the southern Appalachians are darker (Komarek, 1932), whereas those from Labrador are grayer (Bangs, 1896).

The dentition of *M. chrotorrhinus* resembles that of *M. xanthognathus*. Miller (1894) correctly noted that the M3 of *M. chrotorrhinus* possessed three closed or nearly closed triangles of dentine in addition to the usual anterior and posterior loops. Subsequent workers, including Bailey (1900) and Hall and Kelson (1959), described the rock vole as having five closed triangles on M3, and this has commonly been used as a diagnostic character. However, Komarek (1932) observed that the number of closed triangles on M3 was variable, and Guilday et al. (1964) concluded that the five closed triangles was the exception; the percentage of specimens possessing five triangles varied geographically. Three closed triangles on M3 is the most common condition, but the number can range from one (all five triangles confluent) to five (all five isolated). Martin (1971a, 1973a) identified considerable regional polymorphism in the dentition of *M. chrotorrhinus* and attributed this in part to the isolated nature of and extremely restricted gene flow among populations of *M. chrotorrhinus*.

**DISTRIBUTION.** The geographic range of *M. chrotorrhinus* extends broadly across eastern Canada from Labrador and the Maritime Provinces to southwestern Ontario and adjacent northeastern Minnesota and constricts sharply southward through the Appalachian Mountains to North Carolina and Tennessee



FIGURE 1. Photograph of mounted specimen of *Microtus chrotorrhinus* (courtesy of Bell Museum of Natural History, University of Minnesota).

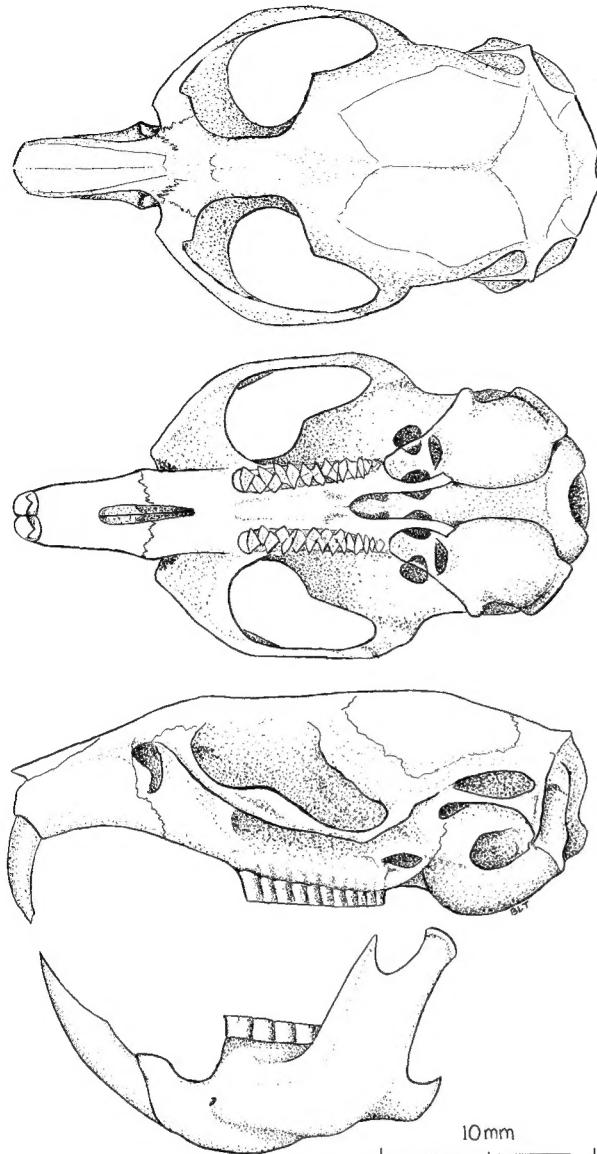


FIGURE 2. Dorsal, ventral, and lateral views of the cranium, and lateral view of the left mandible, of *Microtus chrotorrhinus* (SSC 2674, adult male from West Virginia, Pocahontas Co., 6 mi S Cheat Bridge). Drawings were prepared by Bonnie Tweedy.

(Fig. 3). Recent research has extended the known range of the rock vole to include Cape Breton Island (Kirkland and Schmidt, in press; Roscoe and Majka, 1976). Because of its restricted habitat preferences (see Ecology), *M. chrotorrhinus* appears to exist in isolated populations throughout much of its range. For example, no Recent specimens are known from a 400 km section of the Appalachians extending from Sullivan and Luzerne counties in northeastern Pennsylvania to Tucker County in central West Virginia. Likewise, the recently discovered populations on Cape Breton Island are separated by a hiatus of 550 km from the nearest known populations in central New Brunswick. That rock voles previously inhabited some of the areas from which they are presently unknown is revealed by their occurrence in late Pleistocene cave deposits in southern Pennsylvania (Guilday et al., 1964).

**FOSSIL RECORD.** *Microtus chrotorrhinus* is known from late Pleistocene cave deposits in Pennsylvania (Guilday et al., 1964), West Virginia (Guilday and Hamilton, 1973), Virginia (Guilday, 1962; Guilday et al., 1977) and Tennessee (Guilday et al., 1978). In all of these fossil deposits, *M. chrotorrhinus* is uncommon in comparison with other microtine species, suggesting that at no time have rock voles been abundant. During the Pleistocene, the range of *M. chrotorrhinus* was sympatric with that of *M. xanthognathus*. In cave deposits, *M. xanthognathus* is always

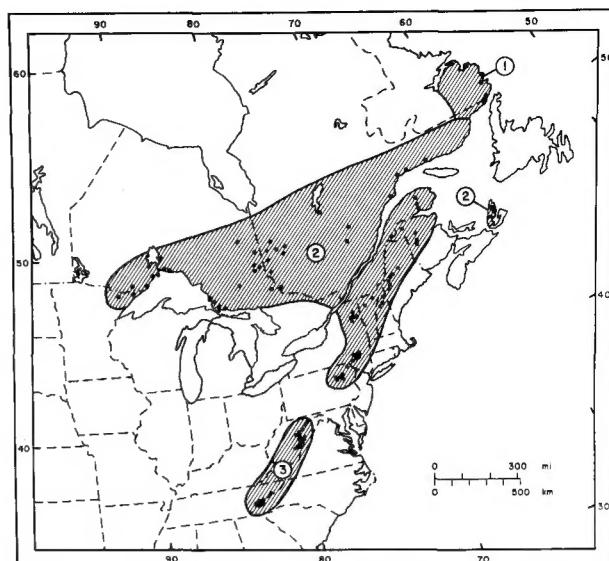


FIGURE 3. Distribution of *Microtus chrotorrhinus*. Subspecies are: 1, *M. c. ravus*, 2, *M. c. chrotorrhinus*, and 3, *M. c. carolinensis*. Dots indicate principal collecting localities for *M. chrotorrhinus*; one dot may represent several adjacent localities. Map was drawn by Tyrone R. Cornbower.

numerically superior. Today, the ranges of these two species are allopatric or possibly parapatric, with *M. xanthognathus* occupying the region to the north and west of *M. chrotorrhinus* (Hall and Kelson, 1959).

**FORM AND FUNCTION.** Developmental molt patterns of the rock vole have been determined by examination of field-trapped specimens (Martin, 1973b). *M. chrotorrhinus* exhibits a juvenile sublateral molt, a post-juvenile sublateral molt, and a diffuse adult molt, all of which are characteristic of the genus. However, there is some evidence of a cephalo-sacral type progression in both the post-juvenile and adult molts. The absence of molting on many specimens is interpreted as interval(s) between sequences.

Rock voles have four pairs of mammae, and Martin (1971a) suggested that the abdominal posterior pectoral pairs showed the most evidence of suckling. The baculum of *M. chrotorrhinus* is of the complex trident type (Hooper and Hart, 1963), consisting of a shaft with one medial and two lateral processes distally (Hamilton, 1946; Martin, 1979). The baculum is similar to that of *M. pennsylvanicus* but has a more pronounced enlargement of the distal end of the shaft, being similar in this respect to that of *M. agrestis*. Medial and lateral processes apparently ossify simultaneously. Prominent separation between the central process and shaft may be present. The lateral processes, when ossified, curve upward and outward. Processes remain attached to the shaft by cartilage and are not ankylosed. Martin (1971a) reported the mean measurements and ranges (in mm) for the bacula of 16 adult specimens as: total length, 3.89 (3.24 to 4.44); length of shaft, 2.67 (2.30 to 3.09); width of shaft base, 1.51 (1.15 to 1.84); width of shaft tip, 0.43 (0.34 to 0.47).

The glans penis, as figured by Martin (1979), uniformly has six papillae on the crater rim, and the urethral process resembles that of *M. oregoni* illustrated by Hooper and Hart (1963).

Bailey (1900) observed that there appeared to be rudiments of side glands on the flanks of two male rock voles he examined. For the subgenus *Microtus*, which includes both *M. chrotorrhinus* and *M. xanthognathus*, he concluded that adult males often have hip glands, but that *M. xanthognathus* had flank glands and *M. chrotorrhinus* "probably" had flank glands. Notation of the occurrence of flank glands in *M. chrotorrhinus* has been repeated (e.g., Quay, 1968), sometimes ambiguously (e.g., Hall and Cockrum, 1953) without any original observations. However, this species does not characteristically have flank glands; rather, most males with scrotal testes and parous females have hip glands (Jannett, unpubl. observ.).

Kilpatrick (cited by Rosen, 1978) found a single hemoglobin banding pattern in electrophoretic surveys of rock vole populations.

**ONTOGENY AND REPRODUCTION.** Rosen (1978) remarked that gestation in the rock vole is 19 to 21 days. Conventry (1937) reported on nine litters from Temagami, Ontario; on the basis of embryo counts, the litter size averaged  $3.56 \pm 0.19$  (range 2 to 5). On the basis of embryo counts, Martin (1971a) calculated for the species an average of  $3.71 \pm 0.19$  (range 1 to 7, mode 4). There is an age-parity effect of increasing litter size as exhibited by larger, heavier, and presumably older females. There is also a tendency for litters to be larger at more northern latitudes (Martin, 1971a). Subsequently, Timm et al. (1977) reported a mean litter size of 3.5 ( $n = 13$ ) estimated from counts of embryos, corpora lutea associated with unimplanted embryos, and recent placental scars; the average litter size was 3.5 based on the four females with embryos. Kirkland (1977) reported a mean embryo count of 2.88 ( $n = 8$ , range 2 to 5, mode 3) for a series trapped in West Virginia in July. Embryo counts from 16 females from Quetico Provincial Park, Ontario, averaged 5.32 (range 3 to 8) (D. W. Nagorsen and R. L. Peterson, in litt.).

Hamilton (1943) stated that rock voles breed from early spring until late fall. Based on reproductive data from museum specimens and his own trapping, Martin (1971a) found that the earliest record of a female in breeding condition was a lactating individual trapped on 31 March; the latest was a lactating female taken on 12 October (both specimens from the Great Smoky Mountains National Park).

Martin (1971a) concluded that reproduction in females, as determined by observation of embryos, placental scars, and previous lactation, generally occurs in voles more than 140 mm (total body length) and 30 g (body weight). There was no obvious correlation between latitude and onset of sexual maturity. The least weight of a breeding female was 21 g; the least total length was 132 mm. Kirkland (1977) reported a pregnant female measuring 131 mm in total length.

Martin (1971a) reported that most field-trapped males had scrotal testes by the time they reached 150 mm total length and 30 g body weight; the smallest males with scrotal testes were 125 mm and 21.5 g. Active sperm were present in the epididymis when the testis was greater than 9 mm long, i.e., when body length was greater than 140 mm. He concluded that testes regressed in the fall but that they remained in the scrotum and were not retracted abdominally. Four of 11 males trapped in Minnesota (Timm et al., 1977) had scrotal testes (average length 12.8, width 7.5 mm), their body weight ranged from 32.7 to 43.7 g, and the smallest was 150 mm total length; all non-reproductively active males were smaller. The average testis size of 11 sexually active males trapped in West Virginia in July was 11.6 by 7.9 mm (Kirkland, 1977).

A postpartum estrus, common among *Microtus*, is indicated in rock voles by lactating pregnant females (Komarek and Komarek, 1938; Linzey and Linzey, 1971; and Martin, 1971a).

**ECOLOGY.** The common name, rock vole, aptly describes the habitat of *Microtus chrotorrhinus*. Rocks and talus are a conspicuous feature of its habitat throughout its range (Grimm and Whitebread, 1952; Kirkland and Kline, 1979; Martin, 1971a; Osgood, 1938; Roslund, 1951; Timm et al., 1977; Wyman, 1923). Water, either in the form of surface or subsurface streams, is another important component of its habitat (Banfield, 1974; Kirkland and Kline, 1979; Martin, 1971a; Wyman, 1923). *M. chrotorrhinus* frequently inhabits sites characterized by an abundance of mosses and forbs. Common ground-cover plants associated with the presence of rock voles are bunchberry (*Cornus canadensis*), bluebead lily (*Clintonia borealis*), Canada Mayflower (*Maianthemum canadense*), false miterwort (*Tiarella cordifolia*), violets (*Viola*), common wood sorrel (*Oxalis montana*), *Vaccinium* spp., Labrador tea (*Ledum groenlandicum*), false Solomon's-seal (*Smilacina* sp.), goldenrods (*Solidago*), mosses, and ferns, including spinulose wood fern (*Dryopteris spinulosa*) (Goodwin, 1929; Kirkland and Kline, 1979; Martin, 1971a; Roscoe and Majka, 1976; Timm et al., 1977; Whitaker and Martin, 1977).

Precise characterization of the habitat of *M. chrotorrhinus* is difficult because of the variety of forest zones occupied and apparent geographic variation in its response to habitat alteration. A prevailing view has been that *M. chrotorrhinus* is largely restricted to the forests of the Canadian Life Zone (Martin, 1971a), inasmuch as the vast majority of the early specimens were collected in boreal forests typical of this zone. Within the past decade, numerous specimens have been collected in primarily deciduous Transition Zone forests in West Virginia (Kirkland, 1977), on Cape Breton Island (Kirkland and Schmidt, in press; Roscoe and Majka, 1976), and in the Adirondack Mountains of New York (Kirkland and Kline, 1979). In West Virginia, Kirkland (1977)

found rock voles were twice as abundant on recent clearcuts of red spruce (*Picea rubens*) and mixed red spruce-deciduous forests (2.23 captures/100 trapnights) as on adjacent uncut forests (0.95/100 trapnights), suggesting that they were actively exploiting the disturbed habitat. In contrast, Martell and Radvanyi (1977) failed to capture any *M. chrotorrhinus* on recent clearcuts of black spruce (*Picea mariana*) forests in Ontario, but found them present in adjacent uncut forests (6.7/100 trapnights) and abundant (28.3/100 trapnights) in selectively cut forests. In Quebec, Goodwin (1929) captured 6 of 10 specimens in a small opening in the forest.

Subsurface runs are typically present among the rocks where rock voles are caught (Banfield, 1974; Timm et al., 1977). A high percentage of specimens are captured in these and other subsurface sites (Kirkland and Kline, 1979; Timm et al., 1977), indicating that *M. chrotorrhinus* spends a considerable amount of time in subterranean activity. This behavior coupled with its restricted habitat may explain why *M. chrotorrhinus* is generally underrepresented in museum collections in comparison with other sympatric species of microtine rodents.

Rock voles share their subterranean habitats with another microtine, the red-backed vole (*Clethrionomys gapperi*), which is frequently captured in traps set below the surface among rocks (Kirkland, unpubl.; Timm et al., 1977). Martin (1971b) concluded that these two species do not compete or exclude each other on the basis of his having captured a relatively unchanging proportion of three *C. gapperi* to one *M. chrotorrhinus* in favorable habitat at both high and low population levels of these species. Kirkland and Kline (1979) found an overall ratio of 2.0 *C. gapperi* to 1.0 *M. chrotorrhinus* in 10 traplines in New York's Adirondack Mountains, although the ratio between these species in individual traplines ranged from 16:1 in favor of *C. gapperi* to 9:0 in favor of *M. chrotorrhinus*. Other common habitat associates of rock voles include the masked shrew (*Sorex cinereus*), smoky shrew (*S. fumeus*), rock shrew (*S. dispar*), short-tailed shrew (*Blarina brevicauda*), deermouse (*Peromyscus maniculatus*), and woodland jumping mouse (*Napaeozapus insignis*) (Kirkland, 1977; Kirkland and Kline, 1979; Roscoe and Majka, 1976; Timm et al., 1977).

Considering its fossil record and present geographic distribution and habitat associations, *M. chrotorrhinus* is clearly a relict species. Why the species is currently so restricted ecologically is not known. Rosen (1978) concluded that physiological limitations did not restrict *M. chrotorrhinus* to its usual habitat. Martin (1971a) reported original and published records indicating the absence of both *M. chrotorrhinus* and *Clethrionomys gapperi* from Newfoundland, and the presence there of *M. pennsylvanicus* in typical *M. chrotorrhinus* habitat; he suggested that *M. chrotorrhinus* competitively excludes *M. pennsylvanicus* from the habitat of rock voles in areas where both occur. Rosen (1978), however, emphasized the close association of *M. chrotorrhinus* and *C. gapperi*, and the apparent exclusion of *M. pennsylvanicus* by *C. gapperi* in forests (Cameron, 1965), and suggested that *C. gapperi* excluded *M. pennsylvanicus*, thereby allowing *M. chrotorrhinus* to occupy habitat which would otherwise be taken by *M. pennsylvanicus*.

Rosen (1978) calculated energy budgets for *M. chrotorrhinus* and *M. pennsylvanicus* over 0° to 30°C ambient and found them to be very similar.

Food habits of *M. chrotorrhinus* from New York, New Hampshire, Labrador, and Quebec were studied by Whitaker and Martin (1977) who found that bunchberry constituted 47% of the volume in 47 stomachs examined. An additional 26% of the volume consisted of unidentified green vegetation, including parts of a variety of higher plants. Other items making up at least 1.0% of the total volume were lepidopterous larvae, a moss (*Atrichum undulatum*), grass stems and leaves, unidentified seeds and roots, *Vaccinium* spp., spinulose wood fern, and fungi, including *Endogone*. Captive rock voles in Minnesota consumed a variety of plants from the capture site, including blueberry (*Vaccinium angustifolium*), bluebead lily, Canada Mayflower, ripe raspberries (*Rubus strigosus*), and bunchberry (Timm et al., 1977). One individual ate all insects it was offered.

Several investigators have captured *M. chrotorrhinus* in association with plants that have been cut and pulled under roots or down into holes under rocks (Goodwin, 1929; Kirkland, unpubl.; Whitaker and Martin, 1977).

Although their subterranean activity may provide some protection from predation, rock voles have been reported as prey for several species. Five *M. chrotorrhinus* were in the stomach of a bobcat (*Felis rufus*) killed in the Great Smoky Mountains National Park (Linzey and Linzey, 1971). Savage (1967) reported rock voles among the prey of the timber rattlesnake (*Crotalus horridus*) and

copperhead (*Agkistrodon contortrix*). Martin (1971a) suggested that *Blarina brevicauda* might be an important predator on *M. chrotorrhinus*.

The following external parasites have been recorded from *M. chrotorrhinus*: Acari—*Laelaps alaskensis* (Martin, 1972; O'Connor and Jannett, unpubl.; Timm, 1974; Tipton, 1960), *Hyperlaelaps microti* (Komarek and Komarek, 1938; Linzey and Linzey, 1973; O'Connor and Jannett, unpubl.; Timm, 1974; Timm et al., 1977; Tipton, 1960), *Haemogamasus ambulans* (Martin, 1972; Timm et al., 1977), *Ixodes angustus* (O'Connor and Jannett, unpubl.; Timm, 1974; Timm et al., 1977), *Ixodes* sp. (Komarek and Komarek, 1938), *Neotrombicula microti* (Buech et al., 1977; Timm et al., 1977), *N. harperi* (Martin, 1972; O'Connor and Jannett, unpubl.; Timm et al., 1977), *Euschongastia peromysci* (Farrell, 1956; Komarek and Komarek, 1938), *Radfordia* sp., *Mycoptes canadensis*, *Trichoecius* sp., *Listrophorus squamiferus*, and *Glycyphagus* sp. (*hypudaei* group) (O'Connor and Jannett, unpubl.); Diptera—*Cuterebra* sp. (Komarek and Komarek, 1938; Martin, 1972); Fleas—*Atypcheras bishopi* (Benton and Cerwonka, 1963; Benton and Smiley, 1963; Martin, 1972), *Catallagia borealis*, *Epitedia w. wenmanni* (Martin, 1972), *Ctenophthalmus p. pseudagyrtes* (Benton and Cerwonka, 1963; Linzey and Linzey, 1973; Martin, 1972), *Megabothris a. asio* (Benton and Cerwonka, 1963; Martin, 1972), *M. quirini* (Benton and Cerwonka, 1963; Martin, 1972; Timm, 1974), *Orchopeas leucopus* (Martin, 1972), *Peromyscopsylla catatina* (Benton and Cerwonka, 1963; Martin, 1972; Timm, 1974), and *P. h. hesperomys* (Benton and Kelly, 1975). These ectoparasites are generally not host-specific, and many have wide geographic ranges (Holland, 1958; Martin, 1972). Cuterebrid larvae were present on 65% of the rock voles taken by Komarek and Komarek (1938), and the moist microclimate of rock voles may be favorable to cuterebrids (Sillman and Smith, 1959). No lice (Mallophaga or Anoplura) have been recorded from rock voles. Palmer (reported by Martin, 1972) examined rock voles from Greene Co., New York, with fungal damage to the ears and small lesions on the throat and body.

Internal parasites include: Cestodes—*Andrya macrocephala*, *Taenia crassiceps* (Martin, 1972), and *Hymenolepis horrida* (Schiller, 1952); Nematodes—*Capillaria hepatica* (Fisher, 1963) and *Cheiropteranema* sp. (Komarek and Komarek, 1938). The internal parasites reported from rock voles are common among microtine rodents. Mundt (1963) failed to find enterococci in the feces of five rock voles from Great Smoky Mountains National Park.

**BEHAVIOR.** There are only incidental comments in the literature regarding the behavior of *M. chrotorrhinus*. On the basis of trapping data, Bangs (1896), Goodwin (1929), and Martin (1971a) suggested that rock voles were primarily diurnal and were most active in the morning. However, Timm et al. (1977) reported that rock voles were active throughout the day and night in northern Minnesota during August.

In live traps, rock voles do not make good cotton nests and survival is sometimes poor (Martin, 1971a). In captivity, they readily consume berries, forbs, and insects (Martin, 1971a; Timm et al., 1977). Timm et al. (1977) considered rock voles docile when handled.

Martin (1971a) opined that rock voles were difficult to maintain in the laboratory. As do many small mammals in laboratory terraria, rock voles largely confine defecation and urination to latrines. Additionally, Martin (1971a) reported trapping a rock vole at a fecal deposit about 500 mm in diameter and 240 mm in depth, deep in a rock crevice, and suggested that retention of fecal pellets in the rectum by rock voles may be related to their use of latrines. Martin found that 17 of 47 rock voles he examined retained from 7 to 33 pellets in the rectum.

Nursing females often but not always excluded the male from the nest in the laboratory (Rosen, 1978). On "several occasions," a male *M. pennsylvanicus* housed with a female *M. chrotorrhinus* achieved intromission but no young resulted, and there was a lack of aggression between these species in the laboratory (Rosen, 1978).

**GENETICS.** Determination of the chromosomal complement of *M. chrotorrhinus* was based on examination of diploid metaphase material from two males and two females (Meylan, 1967). The diploid number is 60, the fundamental number is 64, and all autosomes are acrocentric except for a pair of small metacentrics. The sex chromosomes are giant; the X is submetacentric, and the Y is acrocentric. Meylan (1967) hypothesized that *M. agrestis* of the western Palearctic and *M. chrotorrhinus* had a common Holarctic ancestor, on the bases of their giant sex

chromosomes having similar morphology and size and on the presence of a small metacentric pair of autosomes. De la Guardia et al. (1979) suggested an evolutionary relationship between the Iberian *M. cabrerae* and *M. chrotorrhinus*, largely on the basis of the similarity of the sex chromosomes.

**REMARKS.** *Chrotorrhinus* is from the Greek: color nose. Another common name for *M. chrotorrhinus* is the yellow-nosed vole.

*Microtus chrotorrhinus* has been placed in the subgenus *Microtus* (Bailey, 1900; Hall and Cockrum, 1953; Miller, 1896). Bailey (1900), Komarek (1932), and Miller (1894, 1896) noted or inferred similarities between *M. chrotorrhinus* and *M. xanthognathus* in dentition, color, and presence of flank glands, and Hall and Kelson (1959) suggested a possible conspecific relationship of the two species. However, Martin (1973a) pointed out that variation in dental pattern shown by *M. xanthognathus* encompassed that shown by both *M. chrotorrhinus* and *M. pennsylvanicus*, and that dental characters commonly used as diagnostic in *M. xanthognathus* and *M. chrotorrhinus* (Hall, 1981) were invalid. The baculum of *M. xanthognathus* does not resemble that of *M. chrotorrhinus* (Martin, 1979), the karyotype of *M. xanthognathus* does not resemble that of *M. chrotorrhinus* (Rausch and Rausch, 1974), and the orange facial pattern of these two species may be considered a superficial resemblance (Martin, 1971a). *M. xanthognathus* has well-developed flank glands and flank-gland marking behaviors (Wolff and Johnson, 1979), whereas neither has been observed in *M. chrotorrhinus*, which has hip glands (Jannett, unpubl.). *M. chrotorrhinus* most resembles *M. agrestis* in both karyology and bacular structure.

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